ROCHDALIA, A CARBONIFEROUS INSECT NYMPH

by W. D. IAN ROLFE

ABSTRACT. Since its original description *Rochdalia* Woodward 1913 has been cited as an Upper Carboniferous representative of the branchiopod crustacean Order Anostraca or, more exceptionally, as one of the Trilobitomorpha. Restudy of the unique specimen from Sparth Bottoms, Lancashire, shows it to be a juvenile instar of an insect nymph. Such nymphs are difficult to classify, but *Rochdalia* can tentatively be identified with the family Breyeriidae in the Order Palaeodictyoptera.

With the elimination of *Branchipusites* and possibly *Opabinia* from the Anostraca by Guthörl (1934) and Raymond (1935), only the poorly known *Gilsonicaris* is left as a Palaeozoic member of this order.

ROCHDALIA was described by Woodward (1913) from the Lower Coal Measures of Sparth Bottoms, Rochdale, Lancashire (Tonks *et al.* 1931, pp. 77, 135), and he had 'no hesitation in referring the unique specimen to the Branchiopoda'. Subsequent writers have followed Woodward's view in allying this specimen with the fairy shrimps or Anostraca except Størmer (1944) who referred *Rochdalia* to his Trilobitomorpha. Hutchinson (1930) made *Rochdalia* the type genus of a new family Rochdaliidae and included it in his Order Palaeanostraca with the only other supposed anostracan then known from the Palaeozoic, *Opabinia*. The most recent paper on the genus, by Saavedra (1964), reiterates Woodward's comparison with the Recent *Chirocephalus diaphanus* and attempts an even more detailed morphological comparison, but apparently only from a study of Woodward's figure of the holotype.

Although many crustacean groups are represented only rarely as fossils, it seemed strange to the writer that only the one specimen of *Rochdalia* should have been collected, in view of the comparative abundance of specimens of other arthropods in ironstone concretions of this age. Restudy of the holotype (Manchester Museum L. 11464) and the preparation of the counterpart show the specimen to be an insect nymph, and comparable with other Coal Measure nymphs. In view of the widespread reference to *Rochdalia* as an anostracan it seems advisable to present the following partial synonymy.

Class INSECTA
Order PALAEODICTYOPTERA
Family BREYERIIDAE?

Genus and species *incertae sedis*

Plate 50, figs. 1–3; text-figs. 1, 2A.

? 1904 'larval . . . cockroach . . . ?*Etoblattina*'; Baldwin, p. 527.
? 1908 'nymph . . . of Megasecopteridae . . . to be figured by Dr. Henry Woodward'; Parker, p. 67.
1913 *Rochdalia Parkeri* Woodward, pp. 352–6, fig. 2; Subclass Branchiopoda, Order Anostraca.
1930 *Rochdalia parkeri* Woodward; Hutchinson, pp. 8, 10–13, fig. 3*b*; Suborder Palaeanostraca *nov.*, Family Rochdaliidae *nov.*
1944 *Rochdalia*; Størmer, pp. 93, 135; Subphylum Trilobitomorpha *nov.*, Class *incertae sedis*, Order Opabiniida *nov.* (*nom. corr.* Størmer *in* Moore, 1959).

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1953 *Rochdalia Parkeri* Woodward; Dechaseaux *in* Piveteau, pp. 383–4, fig. 5; Crustacea *incertae sedis*. [Magnification of ×3 wrongly stated as 'gr.nat.']

1960 *Rochdalia*; Novozhilov *in* Orlov, p. 197; Superclass Trilobitomorpha, Class Merostomoidea, Order Opabiniida, Family Opabiniidae.

1964 *Rochdalia parkeri* Woodward; Saavedra, pp. 107–10, fig. 1; Phyllopoda Anostraca, Family Chirocephalidae.

Text-fig. 1B presents a reinterpretation of *Rochdalia* as an insect nymph, based on restudy of the holotype, for comparison with the interpretations of Woodward, Hutchinson, and Saavedra shown as text-fig. 1A. The main differences from earlier accounts are indicated by text-fig. 1 and the following notes. The 'broken base of the peduncle of the eye' is merely a cavity in the internal mould caused by the breaking out of a fragment. This fragment was attached to the external mould and when excavated revealed the continuous pronotal surface beneath. The supposed posterior border of the 'proboscis' is the most posterior and deeply impressed of three diverging grooves on the pronotum which are thought to be homologous with concave wing veins (Carpenter 1954, p. 341).

Excavation of the external mould reveals more of Woodward's 'lateral lamella' and shows it to be almost equal in length to the other ramus, Woodward's 'telson'. The structures are annulated (sixteen articles per mm. proximally) and are clearly cerci. After the photograph for Plate 50, fig. 2 had been taken the distal portions of the wing buds were excavated from the external mould, and these are shown on Plate 50, fig. 3.

The last segment of the ten-segmented abdomen has the tergite produced as a triangular process between the cerci. Cockroach nymphs commonly have the tenth abdominal tergite produced into a pair of ovate lobes, as shown on Plate 50, fig. 4. The unidentified cockroach? nymph shown on Plate 50, fig. 8 has a large oval process projecting from one of the posterior abdominal tergites which might conceivably have had a branchial function.

IDENTIFICATION

Even ordinal attribution of fossil insect nymphs is at present almost impossible (Bolton 1921, p. 67; Carpenter 1948). The best assigned nymphs are those of the cockroaches,

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EXPLANATION OF PLATE 50

Coal Measure insect nymphs. All specimens whitened with magnesium oxide, except those in figs. 4, 7, and 8 which were immersed in xylene (4, 7) or alcohol (8).

Figs. 1–3. *Rochdalia parkeri* Woodward. Right dorso-lateral views of holotype (×3·5). Compare with text-figs. 1, 2A. Ironstone concretion from above Arley Mine Seam, *communis* Zone, Lower Coal Measures, Sparth Bottoms, Rochdale, Lancashire. Manchester Museum L. 11464. 1, Internal mould. 2, External mould before preparation. 3, Latex cast taken from external mould after excavation of distal region of wing buds and removal of matrix forming supposed 'eye peduncle'.

Fig. 4. Flattened abdomen of blattodean, showing cerci (×3). Dorsal aspect; the supposed crustacean '*Pygocephalus* cf. *cooperi*' of Dix and Pringle. Shales above Mynyddislwyn Seam, *temuis* Zone, Upper Coal Measures, Gellideg, Monmouthshire. Geological Survey Museum 25421.

Figs. 5–7. Later instar of *Rochdalia*-like nymph. Left dorso-lateral views. Compare with text-fig. 2B. Ironstone concretion from above Barnsley Coal, *similis-pulchra* Zone, Middle Coal Measures, Round Green opencast site, Barnsley, Yorkshire. British Museum (Natural History) In. 44654. 5, Whole specimen (×2). 6, Thorax, showing tuberculation and venation of wing pads (×3·5). 7, Paranotal folds of abdominal segments 5–7 showing spines (×9).

Fig. 8. Blattodean? nymph, dorsal view (×2·5). Compare with text-fig. 2C. Horizon and locality as for figs. 5–7. Hunterian Museum, University of Glasgow A. 2680a.


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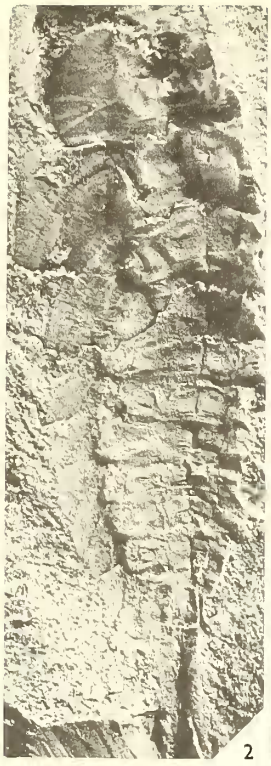
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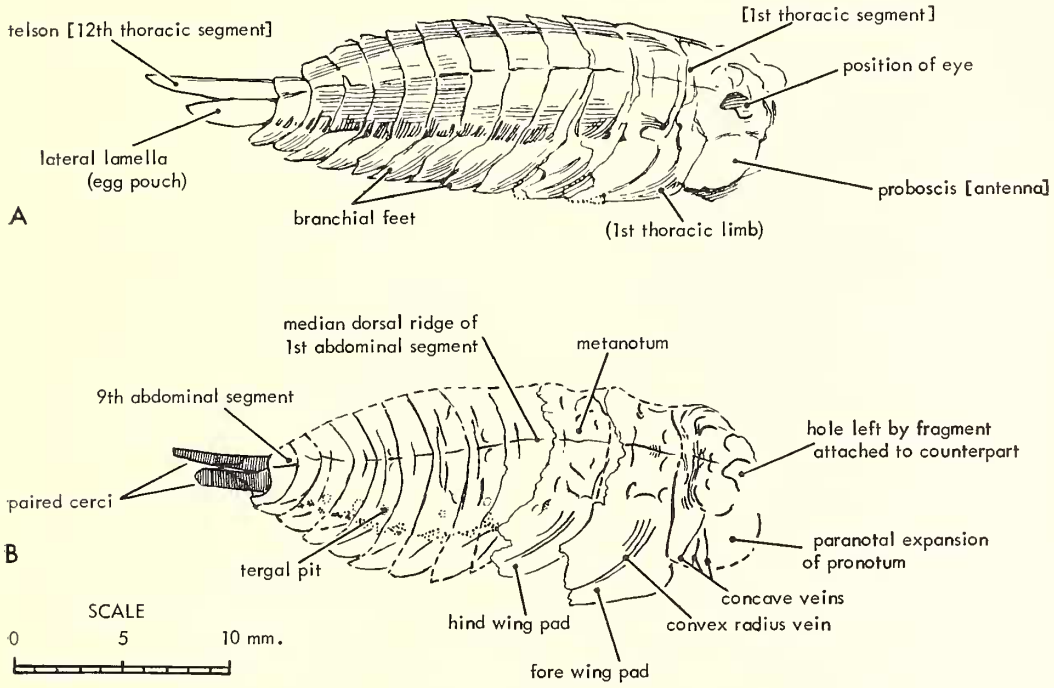
ROLFE, *Rochdalia*, Carboniferous insect nymph

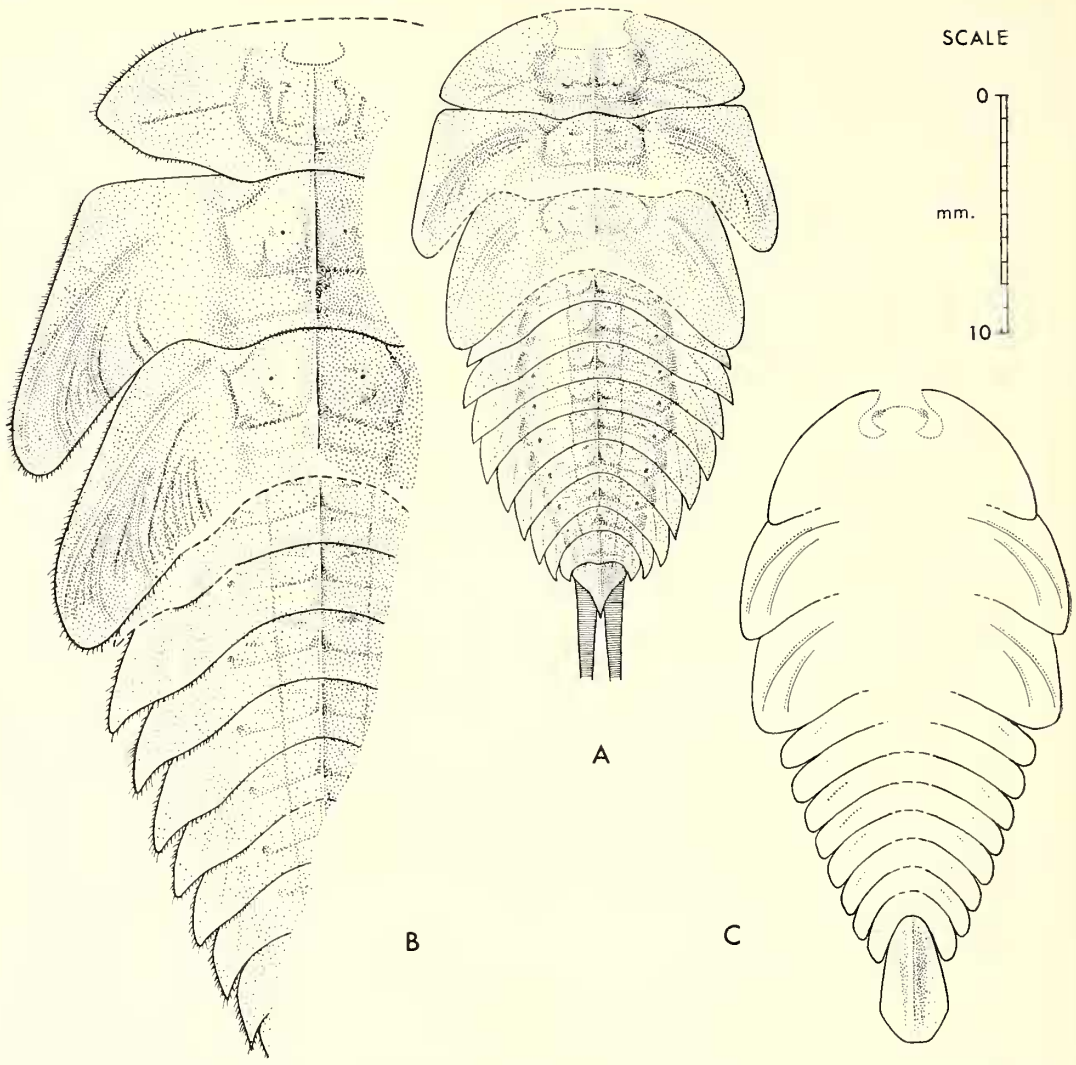
Order Blattodea, which are similar to their modern counterparts (Carpenter 1954, p. 346). Even so, it is worth recalling that Carboniferous cockroach nymphs have been described as notostracan branchiopods under the name *Dipeltis* Packard 1885 (= *Diplodiscus* Schuchert 1897 *nom. null.*) and as a merostome *Schistaspis* Bell 1922 (see Copeland 1957). The writer therefore thought it unwise to attempt to refer *Rochdalia* to



TEXT-FIG. 1. *Rochdalia parkeri* Woodward, internal mould of holotype, Manchester Museum L. 11464. × 3. A. Reproduction of Woodward's 1913 figure showing his view of the morphology as a crustacean with, in parentheses, different interpretations of the same structures offered by Hutchinson (1930—in square brackets) and Saavedra (1964—in round brackets). B. Camera lucida drawing showing present interpretation of the morphology as an insect nymph.

any insect order, although the shape of the pronotum and the relatively large abdomen suggested that it could not be a cockroach nymph, but rather recalled the palaeodictyopteran? nymph figured by Richardson (1956, p. 53).

The size of the wing pads or rudiments and their poorly developed venation shows that *Rochdalia* is an early instar nymph. A nymph recently collected by D. G. Campbell from the Middle Coal Measures at Round Green opencast mine (Mitchell *et al.* 1947; Edwards and Stubblefield 1954, p. 10) and now in the British Museum (Natural History) appears to be a later instar of an identical or closely related insect. It is almost twice the size of *Rochdalia* and shows larger wing pads with well-developed veins (text-fig. 2B; Pl. 50, figs. 5, 6). The median dorsal ecdysial ridge, lobation, grooving and pitting of the tergites, and fine tuberculation of the whole dorsal integument, wing pads included, is common to both nymphs. The prominent convex vein present on fore and hind wing pads of *Rochdalia* is probably the radius and is indentical in position to that in the Round



TEXT-FIG. 2. Coal Measure insect nymphs. Reconstructions of dorsal aspects based on camera lucida drawings and photographs and corrected for lateral curvature and telescoping but not for longitudinal convexity. The nymphs thus appear partially flattened, like the specimens. The lateral spaces between the thoracic paranotal folds would not be present in the convex individual. Dashed lines indicate restored boundaries. Dotted lines on the anterior of the pronota in figs. A and B delimit posteriorly the areas from which cuticle is missing over the site of the underlying head. Drawings by Dr. J. K. Ingham. ×3. A. *Rochdalia parkeri* Woodward. Reconstruction based on internal and external moulds of holotype. Compare with text-fig. 1 and Plate 50, figs. 1–3. Manchester Museum L. 11464. B. Nymph, closely comparable with *Rochdalia*, but a later instar showing better-developed wing pads with strong venation. Compare with Plate 50, figs. 5–7. British Museum (Natural History) In. 44654. C. Nymph of Blattodea? showing posterior tergal plate. Compare with Plate 50, fig. 8. Hunterian Museum, University of Glasgow, A. 2680a.

Green nymph. Illustrations of both nymphs were submitted to Dr. R. Wootton for determination. He states that '*Rochdalia* is almost certainly a palaeodictyopteran nymph as you suspected, and there can be no doubt whatever about the nymph from Round Green'. He tentatively referred the latter specimen to the Breyeriidae.

Insect nymphs have been previously recorded from Sparth Bottoms. Baldwin (1904) and Bolton (1904, 1905) refer to a 'doubtful larval form of *Etoblattina*'. This specimen is now in the Rochdale Museum (Bolton 1904, p. 603), but unfortunately it could not be made available to the writer. It may be this individual that is elsewhere referred to the Megasecopteridae (Parker 1908) although since Parker states that his specimen was to be figured by Woodward he was more probably referring to the specimen which was to become the holotype of *Rochdalia*. Adult insects from this locality are *Mecynoptera tuberculata* and *Spilaptera sutcliffei* (Bolton 1921, pp. 20, 37, 54).

Fragments of insect nymphs will always prove difficult to distinguish from isolated tagmata of crustaceans. One case which has come to the writer's attention may be cited as an example of this difficulty. The specimen described by Dix and Pringle (1930, p. 143) as *Pygocephalus* cf. *cooperi* Huxley (Geological Survey Museum 25421) was incorrectly relabelled *Camptophyllia sp.* by H. K. Brooks in 1962. The 'antennae' of Dix and Pringle are cerci and flank a forked tergal expansion (Pl. 50, fig. 4). The specimen is thus the abdomen of an insect nymph, probably a cockroach, and the few long articles of the cerci imply a young instar.

FOSSIL BRANCHIOPODA OF THE ORDER ANOSTRACA

Van Straelen (1943) and Tasch (1963) have reviewed what is known of the fossil anostracan branchiopods, but the following data can be added to their accounts.

The Middle Cambrian *Opabinia* was removed from the Branchiopoda to the Trilobita by Raymond (1935) and to the Trilobitomorpha by Størmer (1944, 1959). Hutchinson (1930), Linder (1945) and Fryer (1966), however, regard it as 'among the allies of Anostraca'. *Branchipusites* Goldenberg, from the Upper Carboniferous, was suggested to be an *Arthropleura* limb by Guthörl (1934, p. 185).

Thus with the elimination of *Rochdalia* the sole hitherto undoubted Palaeozoic anostracan is *Gilsonicaris* Van Straelen (1943), from the Devonian of the Hunsrück, Germany. The unique specimen is poorly preserved and there seems little evidence for differentiating an eleven-segmented pedigerous 'thorax' from an eighteen-segmented 'abdomen' as suggested by Van Straelen. The 'limbs' of the 'abdominal' segments might have been abraded off during preparation. A possible interpretation of *Gilsonicaris* would then be as a young stage of the arthropleurid? myriapod *Bundenbachiellus? minor* Broili (1930), although the tapering of the posterior region of the body may argue against this. Van Straelen's (1943, p. 3) argument against the presence of a myriapod in the marine Hunsrückschiefer is countered by that of Broili and Verhoeff (*in* Broili 1930, p. 220) which interprets the Myriapoda Macrosterna as amphibious arthropods.

The next oldest record is that of *Branchipodites* Woodward from the Oligocene [*sic*] of the Isle of Wight, and beautifully preserved anostracans have recently been described from the Miocene of the Mojave Desert (Palmer 1957). The well-known Lipostraca of the Devonian Rhynie Chert are closely related to the Anostraca, however, and may indicate that the order is at least that old. *Tesnusocaris* Brooks from the Namurian of